AUTOMATED VESSEL LOGS

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16. ABSTRACT

This project developed a prototype computer-aided vessel log system for the Washington State Ferry System (WSF). The researchers generated three reports that describe the results of their research. This first volume contains a description of the project and summarizes the design and testing results of the prototype automated vessel log.

The second volume contains a two-part guide that describes that prototype software program in details. Part One of this second volume was written for technical administrators who must understand the program's production to enable them to direct refinement of the prototype. Part Two of the second volume was written for the programmers who will develop the code refinements. The second volume also contains the source code listings for all of this project's programs.

The third volume contains a user's guide to the program. A diskette containing all of the program's source code and the executable programs has been sent to the WSF Service Planning Manager at Colman Dock

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Final Report
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Automated Vessel Logbooks

AUTOMATED VESSEL LOGS

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SUMMARY

This report describes the development of a prototype for a computer-aided vessel log system for the Washington State Ferry System (WSF). Three documents were generated for this project. This report contains a description of the project and summarizes the results of the design and testing of the prototype for an automated vessel log. The second document is a two-part guide that describes the software program. Part one of this guide is intended for technical administrators (e.g., Dave Remagen at WSF), and part two is intended for programmers who will refine the code. The second volume of the document lists the source code for all the programs developed with this project. The third document is a user's guide to the program for WSF watches. (A diskette containing all the program source code and executable programs has been sent directly to the WSF Service Planning Manager at Colman Dock.)

By Coast Guard regulation, each WSF vessel must maintain a log of crew actions and events that take place on board. Entries in these logbooks are currently made in long hand by the bridge crew on a carbonless form that creates a copy that is easily detachable from the logbook's binding. Approximately once every ten days, copies from each logbook are sent to the WSF office at Colman Dock, where they are stored for future use.

Unfortunately, these logbooks are difficult and time consuming to use because of the volume of paper involved and the problems caused by hand written notes. Consequently, the logbooks are referenced only for major problems. WSF never uses the majority of data contained in them because the data can not be readily accessed.

This project investigated the development of a computer system to replace the paper logbook. The computer system is designed to collect the same information currently written on the logbook, but to store that information electronically so that WSF personnel can easily access and analyze it.

For the prototype development, the Seattle-Bainbridge Island route was used as a test. WSF management staff and ferry crews were involved in the design, testing, and initial refinement of the system. While minor refinements are still needed before WSF can fully implement the system, tests of the system were successful, and implementation of the system is recommended. This report also describes the actions and expenditures needed to fully implement the system.

CONCLUSIONS AND RECOMMENDATIONS

The project team drew the following conclusions from this project.

- An automated vessel log can be legally used in place of the current paper logbook.

- An automated vessel log can provide significant benefits to the WSF.

- The prototype developed and tested as part of this project meets the vast majority of WSF's needs and, with minor refinements, can be implemented on all routes and on all vessels in the current WSF system.

- WSF crews found the system useful and generally liked it. However, WSF can expect some resistance, based primarily on a general fear and/or distrust of computers.

- A good training program should overcome these fears.

- The cost of complete system implementation, including recommended software enhancements and all necessary hardware, is roughly $240,000. (The details of this cost estimate are given in the Implementation section of this report.)

The project team's recommendations for the WSF are as follows.

- The WSF should proceed with implementation of the automated vessel log system.

- Several enhancements should be made to the prototype's software as part of that implementation, including the addition of more routes to the log's selection of terminals, the addition of miscellaneous routes (e.g., fuel trips) to the log's capabilities, the addition of disciplinary actions to the log's menu system, and refinement of the terminal selection criteria in the menu to account for variations in trip patterns on the San Juan and Vashon routes.

- Recommended hardware improvements include a review of the equipment selected for use on the vessels, the purchase of an effective, red screen filter for use during night operations, and the provision of a computer at Colman Dock with sufficient storage and computing power to handle the data generated by the vessel log software.

- Finally, the project team recommends that WSF provide sufficient funding for a staff person (or consultant) to devote the necessary attention to the system to guarantee successful implementation. Unforeseen "glitches" may occur during the implementation and training phases of this effort, and these "glitches" will only be addressed quickly if some person has primary responsibility for resolving those problems.

INTRODUCTION

This report describes the development of a prototype for a computer-aided vessel log system for the Washington State Ferry System (WSF). Three documents were generated for this project. This report contains a description of the project and summarizes the results of the design and testing of the prototype for an automated vessel log. The second document is a two-part guide that describes the software program. Part one of the guide is intended for technical administrators (e.g., Dave Remagen at WSF), and part two is intended for programmers who will refine the code. The second volume of the guide lists the source code for all the programs developed with this project. The third document is a user's guide to the program for WSF watches. (A diskette containing all the program source code and executable programs has been sent directly to the WSF Service Planning Manager at Colman Dock.)

This final report describes

- the need for an alternative to the current paper log system used on WSF vessels,

- initial design considerations,

- a summary of the design and testing of the prototype,

- a summary of potential improvements to the prototype, and

- conclusions and recommendations for the continued development and implementation of the system.

For more detailed information on other aspects of the system, refer to the programming and user's guides.

PROCEDURES

The work plan for this project consisted of the following seven tasks:

- determine the regulations governing the use of automated logs,

- define the tasks to be performed by the automated system,

- develop a preliminary design for the system,

- determine alternative methods for retrieving data from the computerized log and integrating them with other WSF data,

- program the prototype,

- test and evaluate the prototype, and

- prepare reports and system documentation.

By performing these tasks, the project team was able to accurately determine the important functions of the automated system and produce a prototype for the WSF. The findings of the project are described in the following section.

DISCUSSION

BASIS OF NEED

Logbook Overview

In the WSF system, the bridge crew makes entries in logbooks on each end of each vessel in long hand on a carbonless form that creates a copy that is easily detachable from the logbook's binding. Bridge personnel remove these copies from the log at the end of each shift and store them in an envelope. Approximately once every ten days, at the end of a watch's tour of duty, these collected copies are sent to the WSF office at Colman Dock. The originals, however, stay with their vessel of origin. When a vessel's logbook is filled, it is placed in storage on that vessel, and a new book is opened.

Once these copies reach Colman Dock, they are processed and stored for approximately 5 years[1] in paper form, after which they are discarded. The logbooks are sorted by vessel and date, the drills and incidents that took place are recorded into an Rbase database, and the books are filed in metal filing cabinets near the offices of the operations staff.

The data entry process (recording the data in the database) is laborious, prone to error, and conducted by individuals who have little knowledge of bridge operations and operating conditions aboard WSF vessels. Consequently, the information in this database is sparse and is entered into the computer approximately nine months late.

The intent of the automated vessel log is to provide WSF with this same information, but in an electronic form that makes it both easier to use and more accurate. In addition, it should be available for use by both WSF management and crews.

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[1] Note that the USCG requires that logbooks be kept for one year if they are not official Merchant Marine Logbooks. Please see 46 CFR 78.37-3, reproduced in Appendix B.

The inadequacies of WSF's current logbook system can be classified in two areas:

- storage, and
- information retrieval.

As described above, WSF stores logbook data in two places: Colman Dock and each vessel. The originals remain on the vessel, and copies are filed at Colman Dock. The problem with this storage strategy is space. The paper logs in the Colman Dock offices consume the better part of five large filing cabinets. With the implementation of the automated vessel log, this same information would require considerably less space.

Even with the large space requirements, the primary failing of the current logbook systems is difficulty in retrieving information. To analyze the information contained in the logbooks, the routes or boats of interest and the approximate voyage dates and times have to be identified. Then, each logbook of potential interest must be retrieved from either (or both) the Colman Dock files or the originals on the vessels. Once the records have been found, the information has to be scrutinized to ensure that the appropriate logbooks have been obtained, and finally, if a summary of the collected information is needed, the user must copy the appropriate information from the logbook to an analytical system (e.g., a calculator or computer).

During the course of the logbook retrieval and review, the user may determine that the scope of the search needs to be expanded. Then more logbooks must be retrieved and examined.

This data retrieval process is time consuming and, for some complex searches, inaccurate or incomplete. Bad as it is, this method is only useful for obtaining information on specific, dramatic events, such as the bashing of a wingwall or a collision between vessels. Because the data retrieval process is so time consuming and expensive, statistics cannot be routinely compiled on events such as the number of times a vessel is delayed because of heavy auto traffic, disruptive passengers are dealt with during each year, or ferries are delayed because of heavy vessel traffic in the shipping lanes.

To alleviate these information retrieval problems and retain the present method of long hand entry on board WSF vessels, Colman Dock staff would have to type the contents of each logbook page into a computer database. Given the large number of log pages the entire WSF system generates over one week, this method is impractical. Even now, although WSF staff transcribe less than one-tenth of the information contained in the logbooks, the lag time is over nine months.

Because of this informational bottleneck, this study was commissioned to explore the feasibility of a computer assisted log for the WSF system's vessels.

General Concepts of the Automated Log Book

One possible solution to WSF's current storage and retrieval problems is to replace the paper logbook in each vessel's wheelhouses with a computer aided vessel log (computerized logbook). The computerized log developed in this project consists of an off-the-shelf, PC compatible, notebook-sized portable computer; a pointing device (such as a mouse); a small, quiet printer (such as an ink jet); and custom software. The software (the FerryLog software) is designed around the way the bridge crews currently use the logbooks.

The computerized log should be placed in a convenient location in each wheelhouse and should be used by the crew after each "event" of interest (i.e., departures, landings, checkpoints, incidents, or drills), just as the log is currently used. Between periods of use by the bridge crew, the computerized log would not record information.

The computerized log systems in each vessel's wheelhouses would be completely independent. No information would be shared directly between them, because no computer network would tie the two systems together. However, the computerized log system is designed so that the information from each wheelhouse could be combined at Colman Dock or some other location to understand the actions at both ends of the vessel over one or more watches.

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At the end of some predetermined interval (such as a day, or the end of a watch's ten-day work week), the information accumulated by the computerized log should be sent by computer disk to Colman Dock for further processing and storage.[2] This procedure would replace the current routine of sending the carbonless copies from the logbook of each wheelhouse to Colman Dock at the end of each watch's ten-day work period.

The computerized log takes input only from people. It has no automated information collection system. This distinguishes it from the ill-fated "bell logger" implemented by WSF during the 1970s, which recorded all telegraph signals, rudder changes, and shaft RPMs on a continuous basis. The computerized log also differs from the "bell logger" in the following ways.

- With the exception of the software, the computerized log does not require expensive custom designed parts. Its constituent parts can be found in almost any retail computer store.

- The computerized log does not generate reams of paper output that must be stored and examined by hand. It collects a considerably smaller number of data and does not rely on paper to record data. While the system does allow use of printed paper output as an alternative method of displaying and disseminating the information recorded with it, its primary method of storing and transmitting information is electronic, using standard computer disks.

DESIGN CONSIDERATIONS

Before work began on designing the computerized log, several design objectives were established by the staffs of the Washington State Transportation Center (TRAC), U.S. Coast Guard, and WSF. These design objectives can be categorized as legal considerations, software considerations, and hardware considerations. Each of these subjects is addressed below.

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[2]Please see "Interface to Pier 52" section

Legal Considerations

An original concern of WSF and TRAC staff was that an electronic substitute for the current paper log would not be legal or would not be acceptable to U.S. Coast Guard (USCG) staff. However, upon consultation of the relevant statutes, WSF and TRAC staff determined that an electronic log is a legal substitute for a traditional logbook. WSF vessels are not required to use an official U.S. Merchant Marine Logbook (see Appendix A of this volume for more details). The United States Code (USC) contains no regulations governing logbooks on WSF vessels.

USCG regulations codified in Title 46 of the Code of Federal Regulations (CFR), subpart 78.37, do require that a logbook be kept and that it contain a list of the crew, as well as a record of certain drills and tests that must be performed periodically, but the logbook does not have to follow the standards set for an official U.S. Merchant Marine Logbook (Appendix A contains a copy of the appropriate parts of Title 46). While a signature of the master and chief mate is required in an official logbook (see Title 46, United States Code, section 11302, paragraphs 4 and 5 reproduced in Appendix A), neither the USC nor the CFR mandates that the master or mate's signature be affixed to the logbook that WSF must maintain.

To confirm the USCG requirements regarding signatures, as well as its official and unofficial concerns about replacing a traditional paper logbook with an electronic version, TRAC and WSF staff met with Commander Fitzpatrick of the USCG at Pier 32, Seattle. At this meeting, Commander Fitzpatrick confirmed that the WSF vessels, under normal circumstances, are exempt from using an official U.S. Merchant Marine Log Book. He could see no reason why a computerized log could not be used as a replacement for the current WSF log system, as long as the computerized log contained the same types of information that the traditional paper log now records, and the electronic system met the USCG regulations mentioned above.

The information that should be included in the system includes incidents, drills, inspections, weather, and crew. Commander Fitzpatrick also suggested that WSF alter the way that seamen's offenses and the penalties levied against them are currently recorded. The proposed change would bring the WSF records into agreement with Title 46, United States Code, sections 11301 and 11302 (see Appendix A). He stressed that the logbook should record in some manner the signatures of the master and chief mate (or another seaman, such as the quartermaster), even though existing regulations did not require them. His feeling, shared by WSF and TRAC staff, was that the inclusion of these signatures would increase the legitimacy of the logbook as a legal document.

Software Considerations

One of the overriding concerns that both TRAC and WSF staff had about the computerized log was that it be easy to operate. Most of the WSF bridge crews are not familiar with computers, and the greater the difficulty in learning the system, the greater would be the resistance to its implementation.

Consequently, the prototype of the computerized log's software has a graphical user interface. That is, the computerized log software uses graphical clues such as buttons, pull down menus, and pop up windows on the computer screen to give visual clues about the current status of the system and to help direct the actions of the crew member entering information.

Other features that are built into the prototype software system include the following.

- The software is flexible to deal with the requirements of the different vessels and routes of the WSF system.

- It has limited quality control features to prevent some invalid data from being accidentally entered into the database (such as a departure time of 23:74).

- The software stores the same information that the current WSL logbook contains.

- The software is written to facilitate its own extension and revision as refinements to the system are identified.

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The prototype is currently stable; that is, it doesn't abruptly end execution prematurely. It is in use on one vessel, and can be readily expanded to other vessels on the test route. More on the status of the implementation of the system is presented later in this report.

Hardware Considerations

The primary consideration of the project team when it selected the hardware for the computerized log was that the hardware be based on easily available, serviceable, and replaceable computer components. By specifying hardware that is readily available in the current computer retail marketplace and that is compatible with present WSF computer hardware, the system design ensures that the computer log can be inexpensively maintained and upgraded as operating conditions require.

Secondary considerations in the design and selection of hardware components include the following attributes:

- compactness,

- ruggedness,

- ease of maintenance,

- reliability,

- ease of manipulation (i.e., the keyboard is of good quality, the screen is easy to see both at night and in high glare conditions, the printer is easy to maintain and operate, and the pointing device is easy to use), and

- quiet operation.

The hardware should be compact to fit in confined spaces (such as the "dashboard" on the jumbo ferries). It should be rugged so that it is relatively impervious to the normal vibrations of the vessel. It should be reliable, and in the event of a breakdown it should be easy to repair. Reliability reduces the inconvenience of an inoperative system (the traditional paper logbook would have to be used temporarily) and the expense of frequent repairs. The equipment should be quiet so that it will not degrade the working environment of the vessel's crews.

Finally, the hardware should be at least partially independent from the ship's power. If the ship loses power for a moment or longer, the computerized log should be able to continue to operate uninterrupted, either because of an internal power source or a commercially available uninterruptible power supply (UPS).

Prototype Description

Hardware

The project team selected the following hardware for the prototype:

- Compaq LTE Lite/20 PC compatible notebook computer,

- Cannon Bubble Jet BJ-10ex printer,

- Cannon sheet feeder for BJ-10ex printer, and

- a Kensington Expert Mouse tracball pointing device.

These items were chosen because they met the design considerations described above and because they were affordable. IBM PC compatible equipment was selected instead of Apple Macintosh equipment to allow full compatibility with WSF computer equipment. The Compaq notebook computer is reliable, rugged, compact, and quiet. It has a large screen (relative to other notebook sized, laptop computers) that is fairly easy to see. The Bubble Jet printer is quiet, durable, and is easy to maintain. It is compact for printers of its type, and has good print quality. The Expert Mouse is a high quality tracball and is not as prone to vibrations as a conventional mouse.

For more information on the technical attributes of these items, please see the software program guide, part one.

Software

The software for the computerized log consists of two distinct programs: FerryLog and Combine. FerryLog was designed to run on the computers located in each vessel's wheelhouse. The two computers run independently of each other. Combine was designed to be run at Colman Dock (or some other location) by WSF operations staff to combine the information from each end of a vessel and output a single text file,

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compatible with Microsoft's Excel spreadsheet program. Both programs were designed to run under MS-DOS. However, FerryLog is highly compatible with MS Windows and can be run as a DOS program under Windows.

The software programs for the computerized log system were written entirely by TRAC staff in Borland's C++ 3.1, with the Application Frameworks compiler and software tools package. The Turbo Vision set of software tools, included with Application Frameworks, was used to create the graphical user interface for the FerryLog program, as well as elements of the character based Combine program. For more information about the technical and operational details of the computerized log software, please see the software and user's guide.

TESTING

To test the computerized log system, one set of hardware remained in the TRAC office for testing the FerryLog program, while one set was installed aboard the MV *Walla Walla*. WSF operations staff designated the members of one watch aboard this vessel as the primary beta testers for the computerized log system. WSF staff designated the members of Watch B (Allan Gill, Steve Hopkins, et al.) as the beta testers who would help develop the computerized log by providing oral feedback to TRAC staff on the needs of the watch's bridge crew and how well the computerized log met or did not meet these needs.

This testing took place over five weeks. During this time, the researchers continued to develop and refine the computerized log system. TRAC staff boarded the *Walla Walla* while B Watch was on duty, introduced the newest version of the FerryLog program, and obtained comments, criticisms, and suggestions from the bridge crew regarding the operation of the previous version. TRAC staff then evaluated these suggestions and, if feasible, implemented them in the next version.

In addition, TRAC staff demonstrated versions of the FerryLog and Combine programs to WSF operations staff and solicited their comments and suggestions on

improving these programs to fit their needs. These suggestions, when possible, were incorporated into the software.

Crew members from watches other than the B Watch of the MV *Walla Walla* discovered the computerized log and observed or used it under the supervision of the beta testers. Their comments and suggestions, given directly to the TRAC staff or relayed via the beta testers, indicated an overall positive reaction to the concept and implementation of the computerized log. This sentiment was shared by the primary beta testers, especially Capt. Al Gill and his Chief Mate Steve Hopkins.

A few individuals expressed a distaste for the concept of using a computer instead of paper. Most of this resistance was based not on limitations in the program but on their reluctance to use a computer. This is a common reaction when people are not familiar with computers, and they may view the technology's introduction with trepidation. This resistance can often be eliminated through short training classes and the use of fun computer exercises designed to familiarize the users with simple computer operations.

IMPLEMENTATION

While the tests of the vessel log system were quite successful, the system is still a prototype, not a complete operational model. However, the benefits from the system appear to be real, and the project team believes that the prototype is a good example of how such a system should operate.

To fully implement the system, the following additional actions must take place:

- the software must be revised,

- hardware must be selected and purchased,

- the system for transferring the log data to Colman Dock must be refined, and

- the analysis process once the data get to Colman Dock must be completed.

SOFTWARE IMPROVEMENTS

While the computerized log was designed with all of the WSF standard routes and vessels in mind, it currently is fully functional only for the Seattle to Bainbridge Island route. To make the computerized log fully functional for all routes, additional design and testing must be accomplished. In brief, to accommodate all of the other two-point runs (such as Seattle-Bainbridge Island, or Mukilteo-Clinton), the software maintainer/developer (see below) should observe the bridge crews working these routes for several trips and note the types and sequences of entries made in their logbook, paying special attention to the names of checkpoints on the routes. This information should then be incorporated into the computerized log. Details on how to add this information are given in the User's Guide for the prototype.

For the multi-point routes (such as Seattle-Vashon-Southworth and the San Juan Island routes), the software developer should observe the bridge crews not only for the reasons discussed above, but also to create a method for the wheelhouse crew to easily change arrival and departure information for each wheelhouse. The computerized log is

currently set up so that once a departure-arrival pair is set, it remains the same pair for the duration of the shift. This is not adequate for the Seattle-Southworth-Vashon run, nor for the complex Anacortes-San Juan Island-Sidney routes. While this functionality is not difficult to add to the computerized log, these routes should be surveyed by the software developer/maintainer so that this functionality can be implemented logically.

WSF crew beta testers requested several additions to the prototype that could not be added within the time frame for this project. The two primary additions were a method for recording crew disciplinary actions in the automated log, and the ability to incorporate unscheduled trips in the log. (Unscheduled trips include the movement of a vessel from one route to another, or to or from Eagle Harbor for maintenance, as well as for refueling, sewage disposal, and other miscellaneous reasons.)

Finally, a minor bug in the FerryLog software was not completely fixed. This bug occurred only on the Compaq LTEs used for the prototype, and not on any other computer system on which FerryLog was tested. While this bug was minor, it was irritating in the way that it affected program operation. The project team implemented a "work around" so that the bug would not limit the utility of the system, but the bug should be completely fixed if WSF is going to fully implement the system.

This bug occurs at the end of the program's operation, after all information has been stored and transferred to the floppy disk. After all information has been transferred, under normal operation the program will terminate, the screen will be cleared, and the system prompt (C:>) will return. On the Compaqs, this sequence fails to happen. Instead, the screen does not clear, and the system prompt does not return. Essentially, the system is halted. The computer requires a soft boot to continue. For the moment, this problem can be avoided by running FerryLog under MS Windows 3.1 and utilizing the "force exit" facility built into Windows' DOS task swapper to force the FerryLog program to quit running.

For more details on these and other potential improvements to the computerized log software programs, please see the software program guide.

HARDWARE SELECTION AND PURCHASING

While the computerized log hardware proved, for the most part, to be very capable, some additions and modifications should be considered before the computerized log is fully implemented. Most important is the need for a red filter for the computer screen, as well as a way of dimming the screen intensity more than is currently possible. These are necessary to enable the bridge crew to use the computerized log at night and without losing their night vision—the ability to see objects at night, especially small lights and objects on the horizon.

When it became apparent that the prototype's hardware would be inappropriate for use at night without a red filter, TRAC staff devised a temporary solution. Using velcro and red acetate paper, TRAC staff built a removable red filter that would fit over the log's computer screen. This filter worked reasonably well, in that it allowed the B crew to use the computerized logbook at night without losing their night vision. Unfortunately, this filter is somewhat fragile. Also, it is not perfectly opaque; the back side of the acetate paper is partially frosted, which reduces the clarity of the screen and makes the computerized log more difficult to use. Therefore, to fully implement the computerized log, a better removable red filter should be devised or acquired.

Before the computerized log is fully implemented, WSF operations staff or their contractor should consider the most desirable physical size for the hardware. At the outset of the prototype development, TRAC staff decided that a compact design would be most appropriate. This decision was based on the opinion that on the WSF Jumbo Ferries, the computerized log should be located on the "dashboard" (described above) of the wheelhouse, since this is where the traditional logbook is currently used. The hardware for the prototype was procured accordingly. The researchers also thought that computer portability would be beneficial.

However, testing revealed that the "dashboard" was not an appropriate location for the computerized log. There, the computer tended to catch passing garments or limbs and subsequently be knocked to the floor. The potential for this problem was particularly high at night. WSF crews determined that the best place for the computerized log on the Jumbo class ferries was either on the chart table, or on a specially designed rolling cart that would be placed in each wheelhouse.

Because the dashboard was deemed an inappropriate residence for the computerized log, WSF can move away from the use of a compact notebook computer toward the use of a full sized computer, or a combination of a notebook computer with a full sized monitor. The advantages include less expensive equipment and more features (such as a full color monitor). The use of a full sized monitor might also improve the visibility of the computer screen both at night and during bright summer days. It might also ease the task of finding a red filter.

Additional hardware improvements that should be considered include the use of a surge protector and some kind of security cable. While the computerized log is normally unplugged during the transfer to shore power at vessel tie up, the great potential for a damaging power surge during this power transfer strongly supports the use of a surge protector. The need for an uninterruptible power supply would also increase if a standard desktop computer was used in place of the notebook computer. (Notebook computers contain batteries that can prevent a computer failure during loss of AC power.) Other procedural changes might also be instituted to reduce the effects of power fluctuations on the vessels.

A security device, such as a cable or an Anchor Pad ™, should be used to prevent theft of the computerized log components. The crews participating in the project told TRAC staff that marine radios and other electronic equipment have been stolen from the wheelhouses of various WSF vessels, and the addition of security devices would limit the likelihood of theft.

TRANSFER OF DATA TO COLMAN DOCK

The method selected for transferring data from the computers on the vessels to Colman Dock should be reviewed and refined as part of the implementation process. Two alternatives are described here. One is easily implementable, given the current state of technology and the equipment WSF possesses. The other should be considered a possible method of data transfer after technology has improved and after WSF has begun to implement its long range plans for installing computer networks capable of communicating between WSF vessels at sea and Colman Dock.

Given current technology and equipment constraints, the easiest method of transferring data generated by the computerized log in each wheelhouse is to use the state mail system. (This methodology is already possible with the current logbook program.) For example, at the end of a two-week period, a bridge crew would submit labeled floppy disks from each wheelhouse's computerized log, as well as signed copies of each paper log summary produced by the computerized log's printer for each day of that period. Once these disks had been received in the Colman Dock office, the information from each wheelhouse could be matched using the computerized log Combine program, and then loaded into a database. (The prototype test used Microsoft Excel, but any common database or spreadsheet program could be used as the storage and analysis program for this function.)

The signed paper logs should be stored in the Colman Dock office for at least one year, either in a file cabinet or as an electronic facsimile. The staff could make the facsimile by scanning the document on a standard flat bed scanner and then storing the resulting computer image on a high capacity computer medium, such as a floptical or a WORM diskette.

If WSF pursues its proposed plans for installing a wireless computer network between Colman Dock and its vessels, the computerized log could be integrated into this system. Depending on the exact details of implementation, the log hardware should be

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capable of supporting a wireless network attached to it, and the log software should be able to interface with the network with little or no modification.

COMPLETION OF THE ANALYSIS SYSTEM

The prototype software does not include specific analysis capabilities. Instead, the Combine program produces a delimited ASCII file that can be read into any number of commercially available analysis packages. The prototype's software was tested by reading this file into Microsoft Excel and summarizing key variables. While this type of analysis provides useful data, it was not clear whether this was the most productive use of the log data. A better idea might be to read the ASCII file directly into a database program that provides more powerful search and retrieval capabilities than are available in Excel. The ASCII file might also be read into more than one application. More work is needed by WSF staff to determine how they will want to use this information.

PERSONNEL REQUIREMENTS

If WSF operations staff pursue all the suggestions for implementing and improving the computerized log system recommended by the project team, WSF operations division will need to consider hiring a software developer. This developer would be the responsible for implementing the necessary improvements to the computerized log, training Colman Dock and vessel staff, and transforming and storing data from the wheelhouse. Once the software system has been fully implemented, WSF staff can perform the analysis work, but these staff do not appear to have sufficient time to do the programming, debugging, and training necessary to fully implement the system. TRAC estimates that these tasks could be completed by someone in three to five months if that person was already familiar with the C ++ programming language. Considerably more time would be required if this programming language had to be learned.

An alternative to hiring a temporary staff person is for WSF to contract with an outside vendor to improve and implement the computerized log system and to train WSF

staff to handle the data as they come from the vessels. The problem with this approach is that an outside vendor would need time to gain a sensitivity toward the requirements of WSF operations and vessel staff. It will also be more difficult for an outside vendor to make occasional, incremental improvements to the computerized log software. A developer on the operations staff would be able to make these changes as part of his or her daily duties. In addition, if WSF decided to pursue a computer network between vessels and Colman Dock, this developer could provide invaluable help.

IMPLEMENTATION BUDGET

To fully implement the automated vessel log, expenditures are needed in three areas: procurement of the log's hardware components; procurement of a high performance computer system suitable for storage and analysis of the generated data, as well as refinement of the log's software; and the salary and benefits for the person who writes those refinements.

The equipment estimates below are based on the retail price for equipment similar to that purchased for the prototype. To have sufficient automated log systems for each wheelhouse on WSF vessels, as well as several spares, 60 complete automated log systems should be purchased.

Automated Vessel Log Hardware Cost

Component	Model	Unit Price
Compaq Notebook Computer	LTE Lite 25	$2,600
Canon Bubble Jet Printer	BJ-10ex	330
Automatic Paper Feeder	ASF 6410	90
Kensington Expert Mouse	62364	130
Printer Cable	6" Parallel	10
Sales Tax		$259
Total for one system		**$3,419**
Total for 60 systems		**$205,131**

The cost of analysis system hardware is dependent on the availability of other hardware within WSF. The project team did not carefully survey WSF staff to determine the availability of suitable computer hardware. It may be possible to simply add disk storage to an existing WSF computer to meet the needs of the central computer facility. The processing speed required from this computer is also dependent on whether it is being used for software development and refinement, or simply to store and analyze the data collected from the vessels. The costs below assume that the system is used for software development, as well as for system operation. A less powerful (and less expensive) computer can be substituted for the recommended system if development work will take place on another computer.

Storage and Software Refinement Computer for Colman Dock

Component	Model	Unit Price
Base System	Dell 486 66 MHz	$4,100
PostScript Laser Printer		1,500
500 MB Hard Drive		855
Super VGA Monitor		335
Tape Backup		190
Subtotal		6,980
Other High Capacity Storage Options		
Floptical System (21Mb Disks)		450
Media Price (Per Disk)		25
IOmega Bernoulli Box (90 Mb Disks)		700
Media Price (Per Disk)		119
Software Tools		
Borland C++ 3.1 with Application Frameworks		600
Total Cost (assumes floptical drive, 10 disks)		**$8,280**

The cost of the software developer needed to refine the system and train WSF staff is based on an annual salary of $35,000 and a benefits multiplier of 0.50. The costs could be significantly different than those shown below, given the wide range of options available for hiring temporary computer programming assistance.

Software Developer's Salary

Monthly Salary	$2,917
Monthly Benefit Cost	1,459
Total Monthly Cost	4,376
Total for 5 months	**$21,880**

GLOSSARY

CFR	Code of Federal Regulations
Computerized Log	The hardware and software that comprise the prototype of the electronic log that is the subject of this report
Dashboard	Nickname for a metal ledge located in the wheelhouses of the WSF Jumbo ferries, below the forward windows, port of the radar set and starboard of the helm
DOS, MS-DOS.	Microsoft's disk operating system for IBM personal computers and compatibles
GUI	Graphical user interface
MS	Microsoft Corporation
PC	IBM personal computer and compatibles
TRAC	Washington State Transportation Center
UPS	Uninterruptible power supply
USC	United States Code
USCG	United States Coast Guard
Windows, MS Windows	Microsoft's Windows operating system, version 3.1 for IBM personal computers and compatibles
WSF	Washington State Ferries

APPENDIX A

UNITED STATES CODE

LOGBOOK REGULATIONS

APPENDIX A

UNITED STATES CODE

LOGBOOK REGULATIONS

Appendix A contains reproductions of regulations regarding logbooks from the United States Code.

HISTORY

The history of Title 46, United States Code (USC) is provided below. Chapter 201 of this title was drafted into law in the 19th Century and was enforced until August 26, 1983. This section was repealed and replaced, in its entirety, by Chapter 113 by Public Law 98-89 § 4(b). This chapter was amended by Public Law 98-557 on October 30, 1984. The relevant portions of this chapter, as well as portions of Chapter 115, are reproduced below.

TITLE 46 UNITED STATES CODE

CHAPTER 113. OFFICIAL LOGBOOKS

§11301 Logbook and entry requirements

(a) Except a vessel on a voyage from a port in the United States to a port in Canada, a vessel of the Unites States shall have an official logbook if the vessel is—
    (1) on a voyage from port in the Unites States to a foreign port; or
    (2) of at least 100 gross tons and is on a voyage between a port of the United States on the Atlantic Ocean and on the Pacific Ocean.

(b) The master of the vessel shall make or have made in the official logbook the following entries:
    (1) each legal conviction of a seaman of the vessel and the punishment inflicted.
    (2) each offense committed by a seaman of the vessel for which it is intended to prosecute or to enforce under a forfeiture, together with statements about reading the entry and the reply made to the charge as required by section 11502 of this title [46 USCS § 11502].
    (3) each offense for which punishment is inflicted on board and the punishment inflicted.
    (4) a statement of the conduct, character, and qualifications of each seaman of the vessel or a statement that the master declines to give an opinion about that conduct, character, and qualifications.
    (5) each illness of or injury to a seaman of the vessel, the nature of the illness of injury, and the medical treatment.

(6) each death on board, with the cause of death, and if a seaman, the information required by section 10702 of this title [46 USCS § 10702].

(7) each birth on board, with the sex of the infant and name of the parents.

(8) each marriage on board, with the names and ages of the parties.

(9) the name of each seaman who ceases to be a crewmember (except by death), with the place, time, manner, and the cause why the seaman ceased to be a crewmember.

(10) the wages due to a seaman who dies during the voyage and the gross amount of all deductions to be made from the wages.

(11) the sale of the property of a seaman who dies during the voyage, including a statement of each article sold and the amount received for the property.

(12) when a marine casualty occurs, a statement about the casualty and the circumstances under which it occurred, made immediately after the casualty when practicable to do so.

(Aug. 26, 1983, Public Law 98-89, §1, 97 Stat. 581; Oct. 30, 1984, Public Law 98-557, § 30, 98 Stat. 2875.)

§11302. Manner of making entries

Each entry made in the official logbook—
(1) shall be made as soon as possible after the occurrence;
(2) if not made on the day of the occurrence, shall be dated and state the date of the occurrence;
(3) if the entry is about an occurrence happening before the vessel's arrival at the final port of discharge, shall be made not later than 24 hours after the arrival;
(4) shall be signed by the master; and shall be signed by the chief mate or another seaman.

(Aug. 26, 1983, Public Law 98-89, § 1, 97 Stat. 581.)

CHAPTER 115. OFFENSES AND PENALTIES

§11501. Penalties for specified offenses

When a seaman lawfully engaged commits any of the following offenses, the seaman shall be punished as specified:

(1) For desertion, the seaman forfeits any part of the money or property the seaman leaves on board and any part of earned wages.

(2) For neglecting or refusing without reasonable cause to join the seaman's vessel or to proceed to sea in the vessel, for absence without leave within 24 hours of the vessel's sailing from a port (at the beginning or during the voyage), or for absence without leave from duties and without sufficient reason, the seaman forfeits from the seaman's wages not more than 2 days' pay or a sufficient amount to defray expenses incurred in hiring a substitute.

(3) For quitting the vessel without leave after the vessel's arrival at the port of delivery and before the vessel is placed in security, the seaman forfeits from the seaman's wages not more than one month's pay.

(4) For willful disobedience to a lawful command at sea, the seaman, at the discretion of the master, may be confined until the disobedience ends, and on arrival in port forfeits from the seaman's wages not more than 4 days' pay or, at the discretion of the court, may be imprisoned for not more than one month.

(5) For continued willful disobedience to lawful command or continued willful neglect of duty at sea, the seaman, at the discretion of the master, may be confined, on water and

1,000 calories, with full rations every 5th day, until the disobedience ends, and on arrival in port forfeits, for each 24 hours' continuance of the disobedience or neglect, not more than 12 days' pay or, at the discretion of the court, may be imprisoned for not more than 3 months.

(6) For assaulting a master, mate, pilot, engineer, or staff officer, the seaman shall be imprisoned for not more than 2 years.

(7) For willfully damaging the vessel, or embezzling or willfully damaging any of the stores or cargo, the seaman forfeits from the seaman's wages the amount of the loss sustained and, at the discretion of the court, may be imprisoned for not more than 12 months.

(8) For smuggling for which a seaman is convicted causing loss or damage to the owner or master, the seaman is liable to the owner or master for the loss or damage, and any part of the seaman's wages may be retained to satisfy the liability. The seaman also may be imprisoned for not more than 12 months.

(Aug. 26, 1983, Public Law 98-89, §1, 97 Stat. 582.)

§ 11502. Entry of offenses in logbook

(a) When an offense listed in section 11501 of this title [46 USCS §11501] is committed, an entry shall be made in the vessel's official logbook—
    (1) on the day of the offense;
    (2) stating the details;
    (3) signed by the master; and
    (4) signed by the chief mate or another seaman.

(b) Before arrival in port if the offense was committed at sea, or before departure if the offense was committed in port and the offender is still on the vessel—
    (1) the entry shall be read to the offender;
    (2) the offender shall be given a copy; and
    (3) the offender shall be given the opportunity to reply.

(c) After subsection (b) of this section has been complied with, an entry shall be made in the official logbook—
    (1) stating that the entry about the offense was read and a copy provided to the offender;
    (2) stating the offender's reply;
    (3) signed by the master; and
    (4) signed by the chief mate or another seaman.

(d) In a subsequent legal proceeding, if the entries required by this section are not produced or proved, the court may refuse to receive evidence of the offense.

(Aug. 26, 1983, Public Law 98-89, § 1, 97 Stat. 583.)

APPENDIX B

CODE OF FEDERAL REGULATIONS

LOGBOOK REGULATIONS

APPENDIX B

CODE OF FEDERAL REGULATIONS

LOGBOOK REGULATIONS

Appendix B contains reproductions of regulations regarding logbooks from the Code of Federal Regulations

TITLE 46, CODE OF FEDERAL REGULATIONS, SUBPART 78.37-LOGBOOK ENTRIES

§78.37-1 Application.

(a) Except as specifically noted, the provisions of this subpart shall apply to all vessels.

§78.37-3 Logbooks and records.

(a) Under various statutes or by regulations in this subchapter, vessels engaged in all trades, with the exception of vessels engaged exclusively in trade on rivers of the United States, shall have certain logbooks or records, and, when the occasion arises, it is the duty of the Master or person in charge to place therein specific entries as required by law or regulations in this subchapter.

(b) R.S. 4290, as amended (46 U.S.C. 201), states: "Every vessel making voyages from a port in the United States to any foreign port, or, being of the burden of 75 tons or upward, from a port on the Atlantic to a port on the Pacific, or vice versa, shall have an Official Logbook; * * *." [*Ed. note The preceding is out of date. See Appendix A. 11301*] This Official Logbook is furnished gratuitously to masters of United States' flag vessels by the Coast Guard, as Form CG-706B or CG-706C, depending upon the number of persons employed as crew. There is printed in the first several pages of this Official Logbook various acts of Congress relating to logbooks and the entries required to be made therein. When a voyage is completed, or after a

specified period of time is completed, the Official Logbooks with required entries therein shall be filed with the Officer in Charge, Marine Inspection, at or nearest the port where the vessel may be.

(c) For vessels other than those required to have Official Logbooks by R.S. 4290, the owners, operators, and/or masters are to supply their own logs or records in any form desired, which will be considered to take the place of the Official Logbooks and may be used for the purpose of making entries therein as required by law or regulations in this subchapter. Such logs or records are not filed with the Officer in Charge, Marine Inspection, but shall be kept available for review by a marine inspector for a period of one year after the date to which the records refer.

§78.37-5 Actions required to be logged.

(a) The actions and observations noted in this section shall be entered in the official log book. This section contains no requirements which are not made in other portions of this subchapter, the items being merely grouped together for convenience.

    (1) Fire and Boat Drills: Weekly. See § 78.17-50.

    (2) Watertight door operation: Daily and Weekly. See § 78.17-3.

(3) Valve and closing appliance operation: Weekly. See § 78.17-5.

(4) Loudspeaker system: Weekly. See § 78.17-10

(5) Steering gear, whistle, and means of communication: Prior to departure. See § 78.17-15

(6) Drafts and load line markings: Prior to leaving port, ocean, coastwise, and Great Lakes services only. See § 78.17-20.

(7) Hatches and other openings: All openings and closings, or leaving port without closing, except vessels on protected waters. See § 78.17-35

(8) Line throwing appliances: Once every 3 months. See § 78.17-40.

(9) Emergency lighting and power systems: Weekly and semiannually. See § 78.17-45.

(10) Electric power operated lifeboat winches: Once every 3 months. See §78.17-55

(11) Smoke Detecting System: Once every three months. See § 78.17-65

(12) Fuel oil data: Upon receipt of fuel oil on board. See § 78.17-75.

(13) Cargo gear inspections: At least once a month. See § 71.47-70 of this subchapter.

§ 78.37-10 Official log entries.

(a) In addition to other items required to be entered in the official logbook on every vessel where an official logbook is required, all items relative to the crew and passengers, including the count of passengers carried, and to casualties shall also be entered.

(b) Except as noted in paragraph (b)(1) of this section, on any vessel where an official logbook is not required, the master shall keep a record of the correct count of all the passengers received and delivered from day to day. This record shall be open to inspection by the Coast Guard at all times. The aggregate number of the passengers carried shall be furnished to the Coast Guard whenever requested (R.S. 4467, as amended, 46 U.S.C. 460). The information shall be available for a period of one year after the date to which the records refer.

(1) The provisions of the paragraph shall not apply to ferry vessels.